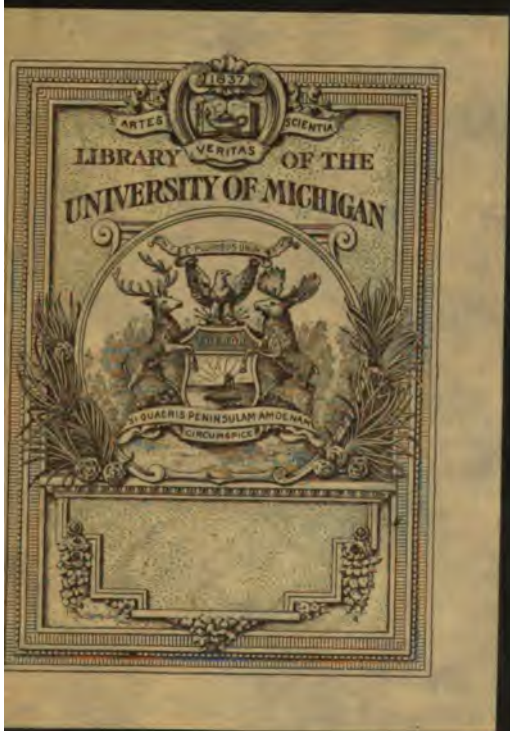
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REPORT OF THE SECRETARY OF AGRICULTURE

ON

THE SOUTHERN APPALACHIAN AND WHITE MOUNTAIN WATERSHEDS

COMMERCIAL IMPORTANCE, AREA, CONDITION, ADVISABILITY OF THEIR PURCHASE FOR NATIONAL FORESTS, AND PROBABLE COST

WASHINGTON
GOVERNMENT PRINTING OFFICE
1908

LETTER OF TRANSMITTAL.

DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, December 11, 1907.

SIR: I have the honor to transmit herewith, in compliance with the provision in the act making appropriations for the United States Department of Agriculture for the fiscal year ending June 30, 1908, a report on the Southern Appalachian and White Mountain Watersheds.

Very respectfully,

JAMES WILSON,
Secretary.

The PRESIDENT OF THE SENATE.

CONTENTS.

ILLUSTRATIONS.

Report of the Secretary of Agriculture

on the

Southern Appalachian and White Mountain Watersheds.

INTRODUCTION.

The agricultural appropriation bill approved March 4, 1907, requires the Secretary of Agriculture to investigate the watersheds of the Southern Appalachian and White Mountains "and to report to Congress the area and natural conditions of said watersheds, the price at which the same can be purchased by the Government, and the advisability of the Government purchasing and setting apart the same as national forest reserves for the purpose of conserving and regulating the water supply and flow of said streams in the interest of agriculture, water power, and navigation."

I have endeavored to have completed all investigations necessary to give Congress the information desired.

Each one of the several problems involved has been handled by the most competent men whose services could be secured. The Forest Service detailed to the work several of its most experienced experts. The Bureau of Soils, after careful field study, has submitted information on soils and agricultural possibilities of the Southern Appalachian region. The Geological Survey of the Interior Department has made available the results of seven years of investigation of water power and navigation conditions of Southern Appalachian streams. Desirous of securing the most competent authority on every phase of the question, I have gone outside of the Government service to secure from Prof. L. C. Glenn, of Vanderbilt University, of Nashville, Tenn., the results of a three years' study of soil erosion in the Southern Appalachians, and from Mr. Philip W. Ayres, of the Society for the Protection of New Hampshire Forests, a report on the commercial importance of the White Mountains.

Approaching their subjects from different points of view, these men without a single exception have arrived at results which lead irresistibly to these conclusions, namely, that the Southern Appalachians and White Mountains are of vast commercial importance to the industries of the country; that the good or evil influence of these regions in an unusual degree depends upon the treatment given them, and that both are encountering well-advanced destructive influences, which, unchecked, will bring widespread devastation to the regions themselves and ruin to many of the industries of this country.

Therefore, in this report I desire to repeat and strongly emphasize my recommendation of six years ago, that the National Government undertake the purchase of a definite portion of these mountain forest lands, in order that they may, through use as national forests, be protected and improved. My former recommendation applied only to the Blue Ridge and Great Smoky Mountains. I am convinced now that the Government should extend its purchases to the Southern Allegheny and the Cumberland Mountains and to the White Mountains also.

A great opportunity presented itself to the Government in the purchase of these lands seven or eight years ago. The influences which are destroying the mountains were not then so far advanced. Virgin hardwood timber lands existed in large areas and could have been bought at from $1 to $5 per acre. Within the past eight years we have crossed the threshold of a hardwood timber famine, and in consequence the prices of such virgin hardwood lands as remain have advanced from 300 to 500 per cent.

It will be the wisest course under present conditions for the Government to purchase cut-over rather than virgin lands. Even cut-over lands with no prospect of a timber crop inside of ten or twenty years will cost as much now as virgin lands ready for the saw would have cost eight years ago. Barren and eroded lands, of which there is a greater area now, will cost no more to-day than in the past. But considering the expense of planting timber on them and the time before returns can be secured they become the most costly class of lands that can be purchased.

That the two regions under consideration are advancing toward a condition of barrenness and sterility is the conclusion of every man who has had a part in this investigation. I do not refer to the loss merely of commercial timber. I mean absolute barrenness and sterility—without timber, without undergrowth, without soil. In 1896 Prof. N. S. Shaler, of Harvard University, said:

> South of Pennsylvania there is, according to my reckoning based on observations in every State in that upland country, an aggregate area of not less than 3,000 square miles where the soil has been destroyed by the complete removal of the woods and the consequent passage of the earthy matter to the lowlands and to the sea. At the rate at which this process is now going on the loss in arable and forestable land may fairly be reckoned at not less than 100 square miles per annum. In other words, we are each year losing to the uses of man, through unnecessary destruction, a productive capacity which may be estimated as sufficient to sustain a population of a thousand people.

This rate has not only been kept up; it has been greatly accelerated. Faster than was considered possible eleven years ago these regions, through injudicious cutting, fires, clearing, and general misappropriation, are moving toward a forestless, soilless condition.

If we wait till forest and soil are gone before beginning a sound policy of handling these mountains, we shall invite the bitter experience of France, who at infinite pains and an expenditure of $40,000,000 is endeavoring to restore both soil and forest to her mountains after a course of destruction such as ours at present.

How the destruction of the Appalachian forests, north and south, means far-reaching damage to the country is pointed out in this report. The Appalachians must be almost the sole dependence for the nation's future hardwood supply. If this supply fails, the hardwood-using industries of the country must fail, and the entire

country be in want of hardwood materials which in the past it has had in great variety and abundance. The streams of the Appalachians are of enormous value to the nation for water power and navigation. If the forests are removed from the mountains, this value will be reduced to a fraction, because the soil from the denuded watersheds will so rapidly fill reservoirs and channels that even the resources of the Government itself will be insufficient to keep them clear.

That some special means must be taken to protect the resources of these mountains no reasonable man after a full study of the situation is likely to deny. The time to begin is now. Every year that action is deferred the conditions are made worse and the cost of reclamation becomes commensurately greater. The undertaking is so immense that the National Government can not be expected to assume it alone. Important action must be taken by the States directly concerned, and extensive cooperation must be had with individual landowners of the region. It is the duty of the Government to undertake a part of the work and to do it without delay, in order that by example and influence it may lead the way to the more rational treatment of these regions and their resources.

In this report it is pointed out how far, in my opinion, it will be necessary for the Government to go and what the cost will be. I have also indicated the action which it seems necessary for the several States to take, and have suggested a basis for securing the cooperation of individual landowners. All three—Government, State, and individual—must, it seems to me, participate in the movement.

As a result of the work done under the special appropriation, several reports are being published which show how the commercial importance of these regions depends upon keeping their forests under systematic control. The water resources branch of the Geological Survey, under the direction of Mr. M. O. Leighton, has prepared two reports, one on the Relation of the Southern Appalachian Mountains to the Development of Water Power, the other on the Relation of the Southern Appalachian Mountains to Inland Water Navigation. The report of Mr. Philip W. Ayres, already referred to, on the Commercial Importance of the White Mountains, is being published. Mr. William L. Hall, of the Forest Service, has published a report on The Waning Hardwood Supply and the Appalachian Forests. All of these papers are respectfully brought to the attention of Congress as containing in large part the data which form the basis of the conclusions and recommendations of this report.

IMPORTANCE OF APPALACHIAN FORESTS FOR HARDWOOD SUPPLY.

The future hardwood supply hinges on the control of the Appalachian Mountains. This is shown in Circular 116 of the Forest Service, on The Waning Hardwood Supply and the Appalachian Forests. To briefly summarize the reasons, the hardwood lumber cut of the country has fallen off over 15 per cent in the last seven years, and this decrease took place at a time when the industries made unprecedented demands upon every kind of structural material. The output of pig iron increased 86 per cent, that of cement 229 per cent,

without hindrance. Every year millions of young trees, the hope of the future crop, are killed and the humus, the great storehouse of fertility and moisture, is consumed over thousands of acres. Through mismanagement a great part of the young timber has been destroyed. Much that remains is damaged by fire, insects, or fungi. Over the whole area the average growth is very little, probably not more than 10 cubic feet per acre annually.

The inevitable conclusion is that there are lean years close ahead in the use of hardwood timber. There is sure to be a gap between the supply which exists and the supply which will have to be provided. How large that gap will be depends upon how soon and how effectively we begin to make provision for the future supply. The present indications are that in spite of the best we can do there will be a shortage of hardwoods running through at least fifteen years. How acute that shortage may become and how serious a check it will put upon the industries concerned can not now be foretold. That it will strike at the very foundation of some of the country's most important industries is unquestionable. This much is true beyond doubt, that the hardwood timber famine is upon us and we have made no provision against it.

Studies of the forest conditions in the Southern Appalachians show that these lands, where they have been under protection for some time, are capable of producing an average of 50 cubic feet of wood per acre annually. Even taking the production at 40 cubic feet, this means for the area of 75 million acres a possible annual production of about 3 billion cubic feet, which is about equal to the present consumption of hardwood timber for all purposes. Since the Appalachians at present supply only 48 per cent of our hardwood, and since other regions will continue to furnish some, it is likely that the proportion from the Appalachians will never exceed 75 per cent. This allows a margin of safety of 25 per cent if we assume that there will be no increase over the present rate of consumption. If the Appalachian forests are taken soon enough and rightly handled they will eventually produce continuously three-fourths of the hardwood supply of the country, and do it without exhausting the forests. In fact, it can be done in such a way as to improve the forest.

Our experience will doubtless be the same in this respect as that of Germany. In Saxony the cut, which represents only the growth, increased 55 per cent during the period from 1820 to 1904, bringing the annual yield to 93 cubic feet per acre. Prussia shows a still more pronounced increase. In 1830 the cut was only 20 cubic feet per acre, and in 1865 had increased to only 24 cubic feet. But in 1890, owing to proper management, it had risen to 52, and in 1904 to 65 cubic feet. These results came largely from nonagricultural lands, sandy plains, swamps, and rough mountain slopes, and from forests which had been mismanaged, much the same as ours. Under right management an equal increase may be expected from Appalachian forests. To this increase of yield we must look to meet the increase which is certain to come in demand.

IMPORTANCE OF SOUTHERN APPALACHIANS AND WHITE MOUNTAINS FOR WATER POWER.

The amount of water power in the Southern Appalachians frequently has been guessed at. The Geological Survey has been measuring the streams for seven years, and its report on the Relation of the Southern Appalachian Mountains to the Development of Water Power presents facts concerning the remarkable asset the nation has in the water resources of this region. Based on the lowest two weeks of the year an average for seven years shows that the streams afford 2,700,000 horsepower. This much power would be available the year round. In common practice it is found profitable to develop a water power to the minimum of the four high-water months of the year, depending upon steam power during low-water season to make up the deficiency. In order to be conservative in this estimate the time limit has been made six months. No streams or portions of streams were considered that did not flow out of the Southern Appalachians. No streams with less than 500 horsepower were considered. In all calculations only 90 per cent of the observed fall and 80 per cent of the energy of the falling water is used. Moreover, three important streams—the Big Sandy, the Cumberland, and the Kentucky—are not included. With these allowances and omissions the minimum power for the year and for the six high-water months is as follows:

TABLE 2.—*Minimum horsepower of Southern Appalachian streams.*

Stream.	Horsepower.	
	Minimum for the year.	Minimum for six high-water months.
Potomac	131,800	349,556
James	155,000	236,474
Roanoke	131,000	215,709
Peedee	167,800	256,945
Santee	319,590	472,000
Savannah	209,000	314,600
Chattahoochee	145,000	228,800
Coosa	104,580	177,880
Monongahela	58,900	235,715
Great Kanawha	335,000	853,420
Tennessee	973,600	1,589,474
Total	2,740,700	4,929,573

The above table shows the power available under present conditions. Development of the storage facilities of the various streams would increase the minimum from three to thirty times, depending upon the stream.

It is estimated by the Geological Survey that at least 50 per cent of the indicated minimum horsepower, and probably much more, is available for economic development. On this basis the rental of 1,350,000 horsepower at $20 per annum is worth $27,000,000 per year. If we take in the same way 50 per cent of the power which is present for half the year we increase this sum by $11,000,000, bringing the total to $38,000,000.

Until a few years ago scarcely any of this power was utilized.

Since 1900, with an increase in population of about 2,400,000, or something more than 10 per cent, the South has increased the value of its farm products by $728,000,000, or 57 per cent, and the value of its manufactures $761,000,000, or 52 per cent. It has added 3,493,000 spindles to its cotton-mill outfit, an increase of 55 per cent, and its mills used in 1906 about 2,375,000 bales of American cotton, or 48 per cent more than in 1900. In the six years the South's annual pig-iron production has increased by 896,000 tons, or 34 per cent; its coal production by 34,202,000 tons, or 69 per cent; the value of exports at its ports $177,000,000, or 38 per cent. In that time its railroad mileage has increased by 11,441 miles, or nearly 22 per cent, and the assessed value of property by $2,490,000,000, or nearly 48 per cent. [Manufacturer's Record.]

This showing is not made by the South alone. It represents the results of capital from all parts of the country applied to the development of the resources of the South. It is therefore national, not local, development.

Coincidental with this industrial advance has come about a strong demand for electricity generated by water power. Electric development plants have sprung up on nearly all streams, and in great numbers on those flowing through the Piedmont Plateau. While relatively little of the nearly 5,000,000 horsepower is as yet utilized, its utilization is increasing at a marvelous rate.

Ready power to the value of $38,000,000 will give the country tremendous advantage, not alone in manufacturing, but in transportation, in lighting, and in every kind of development. Water power is especially valuable to those sections which have no deposits of coal, and its advantages will steadily enhance in the future as the supply of coal grows scarcer and the price correspondingly higher.

On the great watersheds forming the White Mountain region the four most important streams of New England have their rise. Upon them are located the great cotton, woolen, and paper mills of New England. They abound in fine water power, only a part of which is now utilized. It has been estimated that the capital invested in the manufacturing enterprises which utilize the power of these streams amounts to $250,000,000. Important and flourishing cities have grown up in consequence of these industries. Bellows Falls, in Vermont; Manchester and Berlin, in New Hampshire; Holyoke, Lowell, and Lawrence, in Massachusetts; and Biddeford, Brunswick, and Lewiston, in Maine, are representatives of such cities, ranging in population from 10,000 to 150,000.

The Connecticut River, the largest of New England streams, rises in the Connecticut Lakes of northern New Hampshire. It forms the boundary between Vermont and New Hampshire for 180 miles and flows across Massachusetts and Connecticut for 120 miles. Its drainage basin includes 10,924 square miles, of which nearly one-fourth lies in New Hampshire and one-tenth in the White Mountains. The White Mountains portion of its watershed averages nearly 4,000 feet in elevation, including portions of the great Presidential and Franconia ranges. Their slopes are steep and rocky, without large lakes or swamps, and with only the forest to retard the run-off. Water power in the upper stream is developed chiefly at Fifteen Mile Falls and McIndoe Falls on the main river and at Littleton and Lisbon on the Ammonoosuc. Below McIndoe Falls are long reaches of smooth water broken at Bellows Falls, Turners Falls, Holyoke, Windsor Locks, and three other points by falls having an average aggregate

during ten months of the year of 120,000 horsepower. Less than half is utilized.

In very low water the power is reduced nearly one-half, so that but a small margin remains over the amount required for daily use. At Holyoke, Mass., the margin is frequently so small as to require the most careful use of water to make the supply meet the needs. The census of 1880 reported for the Connecticut and all of its tributaries 2,298 mills using 118,026 horsepower developed from the streams. It is estimated that these figures have since been increased by about 20 per cent, making the present total over 140,000 horsepower.

The Merrimac River is undoubtedly the most notable water-power stream for its length in the United States. Between Franklin and Newburyport, a distance of 110 miles, it has a fall of 269 feet, of which 185 feet is developed, representing approximately 50,000 net horsepower. Of the remaining 84 feet, it is believed that less than half can be utilized. Probably the total development in the main stream will not exceed 60,000 horsepower. Its great water powers are at Manchester, N. H., and Lowell and Lawrence, Mass. On the tributaries of the Merrimac valuable powers also exist. Those at Franklin on the Winnepesaukee are equal in value to some on the main stream. The Merrimac is formed by the Pemigewasset and Winnepesaukee rivers. The latter has its source in the lake of the same name, while the former rises in the Franconia Notch of the White Mountains and drains a large area of high, mountainous country. Since the Pemigewasset has no lakes or swamps to conserve its waters, it depends upon the forest cover alone for its regularity of flow.

The Saco River rises in Crawford Notch, in the heart of the White Mountains, and drains a larger proportion of the principal ranges than any other stream. None of its tributary streams from the mountains have lakes to restrain their waters, though, like the Merrimac at its lower levels, it is the outlet of important lakes. Toward its headwaters the Saco is variable in its flow and has no important water powers, but on its lower reaches in Maine its flow is broken at six places by falls, affording water power of a high value. At Saco and Biddeford, at Union and Salmon Falls, and at Bar Mills fine water power exists, a large part of which is utilized. At Hiram, 45 miles from the sea, is found the most extensive power on the river. The Saco, while its possibilities are great, is more dependent upon the forest cover for the evenness of its flow than any other river having its source in the White Mountains.

The Androscoggin River has a drainage basin with a higher general elevation and a larger lake system than any other New England stream. It is formed by the union of Magalloway River and the outlet of Umbagog Lake, at Errol, N. H. At its headwaters is the magnificent system of Rangeley Lakes, the outlet of which is controlled by dams. The flow of the upper river is therefore very uniform.

Farther down its course the Androscoggin receives the drainage of the northern part of the principal ranges of the White Mountains through Peabody and Moose rivers. On this part of its drainage there are no lakes of importance. The water powers of the Andros-

coggin are centered at Berlin, N. H., and Rumford Falls, Livermore Falls, Lewiston, and Brunswick, Me. In the 167 miles between tide water and Umbagog Lake there is a fall of 1,235 feet, of which 610 feet is used, corresponding to about 120,000 net horsepower. Of the remaining 625 feet, possibly two-thirds can be utilized, corresponding to 60,000 net horsepower, and bringing the total to about 180,000 horsepower, or approximately three times that of the Merrimac without its tributaries.

The streams of the White Mountains, therefore, furnish power for great industries, and are the basis of development for many prosperous cities in all the New England States but one. These streams are all influenced vitally in flow by the forest which covers the slopes of the White Mountains.

APPALACHIAN MOUNTAINS IMPORTANT TO NAVIGATION.

Timber supply and water power are not the only factors which make the Appalachian Mountains commercially important. All the water gathered by the Southern Appalachian and White Mountains flows to the sea through navigable rivers. With greater elevation than other parts of the watersheds the mountains receive much more rainfall, and with their cooler climate the evaporation is less; hence there is more water to be discharged. Because of the precipitous slopes of the mountains the run-off is far more rapid than in other sections. To this must be added the fact that in the Southern Appalachians there are no natural lakes to gather the flood waters and equalize the flow of streams. There are thus two powerful influences contributing to an extremely heavy discharge from these mountains, and two more contributing to an extremely rapid run-off. Combined, these tend to produce great variability in the flow of all streams which have a large part of their watersheds in the mountains.

A large regular discharge coming from springs is desirable, a variable surface run-off is bad from every point of view, and so far as possible should be remedied. The variability of the present flow of Southern Appalachian streams is so great that though the average volume would make the streams constantly navigable, they are at extreme flood during a few weeks of the year and at extreme low water during a much longer period. Their low-water stage causes interference and loss to business through the cessation of navigation; their high-water stage often entails damage and loss from floods.

There is but one natural factor which tends to equalize the flow of Southern Appalachian streams—the forest. In one continuous mantle, covering ridges, slopes, and coves, it has for untold ages been nature's sole reliance for the proper distribution of rainfall. If storm and deluge came, the downpour fell upon a foot-deep layer of humus, which readily received many times its own weight of water before it allowed any to escape. When filled, it passed on the excess to a soil made porous by myriads of penetrating roots and countless tons of vegetable mold. If drought came, it found the humus and soil filled as a reservoir with water for the steady supply of springs and streams through weeks or months of rainless weather.

The original forest, then, with its characteristic conditions of shade, undergrowth, humus, and soil, was an effectual distributer of moisture.

It was as efficient as would have been a system of lakes. It had power to hold back the water on a steep mountain side almost as though the ground were level. Thus, in a great measure, it equalized all influences which contributed to the variability of the run-off.

This balance of conditions began to be disturbed when the forest was cleared from great areas of foothill land. It has become strongly disarranged since the clearing has extended far up the mountains and since the forest has been opened by cutting and the humus consumed by fire over almost the entire area.

In view of the fact that over large areas of the upper watersheds of the Southern Appalachian streams the forest can never be restored, the possibilities of artificial storage become important. In the report of the Geological Survey on Relation of Southern Appalachian Mountains to Inland Water Navigation data are presented for each navigable stream to show the available reservoir sites, the amount of water which can be stored, and the effect of such stored water on the minimum river stage for specified periods. The data for some streams show that remarkable results can be accomplished. As a striking example one may consider the Savannah, which during the greater part of the year is navigable for steamboats drawing from 4 to 5 feet of water, but during low-water seasons there are various shoals in the upper part of the river with a depth of not over 3 feet. In pursuance of the plan of improvement outlined by the Chief of Engineers, United States Army, the United States had expended in the improvement of this river up to June 30, 1905, the sum of $517,643, of which $58,935 was expended above Augusta. The estimate of cost to complete the project is $645,045. Expenditures on the upper portion of the river have now been suspended on the ground that the permanent improvement of this portion would involve an expenditure out of proportion to the prospective commercial benefits.

Considering this condition, it is of interest to note what can be done by means of a storage system on this river. Topographic surveys have located 14 reservoir sites, which, if developed, would have a capacity equal to the annual run-off of 1,670 square miles of drainage area, or 23 per cent of the drainage area above Augusta. With these reservoirs developed and filled, the amount of water which could be stored would be sufficient to maintain an added depth of 9 feet at Augusta for a period of 118 days, or practically four months. Even with the reservoirs half full at the beginning of the low-water season there would still be water enough to add 5 feet to the depth of the river for 130 days. The Savannah, already a river of great commercial importance, would have its commerce increased many fold if only a good navigable depth could be maintained at all seasons.

It is not pertinent here to consider whether at a future time it may be desirable to plan a general system of such reservoirs. It is important to point out that every reservoir developed for water power in the mountains or foothills helps conditions in the navigable courses of the streams. Owing to the great water-power development which is taking place, this aid is likely to be of considerable value in the future. When in addition to seeking improved conditions of navigation it is of equal or greater importance to control the floods, as in the Monongahela River, such work may become entirely feasible.

The Weather Bureau carefully investigated the damage along the Ohio River from the floods of January and March, 1907, and found that the property loss, not including damage to soil and river channel, amounted to $9,900,000, most of which was sustained by the city of Pittsburg. The report of the Geological Survey shows that the flow of 1,950 square miles, or 35 per cent of the drainage area of the Monongahela, can be stored for a full year, and that by such storage the low-water stage in the Monongahela can be increased by 6 feet throughout the longest dry-season period ever known in the history of the river. The measurements show that by the storage of this water in the Monongahela an increase of stage of 3 feet can be effected in the Ohio River at Wheeling for a period considerably longer than four months. This means a distinct improvement for both navigation and flood conditions. With 35 per cent of the Monongahela water subject to storage, the flood damage at Pittsburg and Wheeling would be almost eliminated. With the minimum stage of the Ohio at Wheeling increased by 3 feet, the coveted 9-foot stage between Pittsburg and Cincinnati would all but be secured.

The streams which drain the White Mountain region are all navigable in their lower courses. The Connecticut River is the most important for its commerce. Commerce in considerable volume is carried on from the mouth to Hartford, 30 miles, and small boats by way of the Windsor Locks may ascend as far as Holyoke, Mass. The Androscoggin, Kennebec, and Saco in their upper courses are used to a large extent for the driving of logs. The lower Kennebec supports an extensive ice traffic.

FOREST DETERMINES POSSIBILITIES OF WATER POWER AND ARTIFICIAL STORAGE.

The forest bears a vital relation to successful utilization of water power and effectual artificial storage. No matter what its purpose or design, any reservoir system developed in the Southern Appalachians is foredoomed to failure unless the watersheds which feed it are kept under forest. The present torrential discharge of the streams is due to the extent to which the forest has been cut away or damaged. The more this sole equalizing factor is lessened, the more extreme will be the floods on the one hand and low-water stages on the other. A mountain watershed denuded of its forest, with its surface hardened and baked by exposure, will discharge its fallen rain into the streams so quickly that overwhelming floods will descend in wet seasons. In discharging in this torrential way the water carries along great portions of the land itself. Deep gullies are washed in the fields, and the soil, sand, gravel, and stone are carried down the streams to points where the current slackens. The stone and gravel are likely to be dropped in the upper channel of the stream, to be rolled along by subsequent floods, but the sand and silt are carried down to the still water of the first reservoir, where they are deposited. It is this silting up that makes uncertain any reservoir system outside the limits of a forested watershed.

Since the extensive removal of the forest on the upper watersheds there has been a vast accumulation of silt, sand, and gravel in the upper stream courses. Examples of reservoirs completely filled are already to be seen on almost every stream. Removal of the silt is

usually impracticable. If sluiced out of the highest reservoir, it gathers in the next below, and so on through whatever system may have been developed. If, perchance, it should pass the last reservoir, the silt is then free for deposit in the navigable stretches of the stream.

Regardless of whether there are reservoirs, the ultimate deposit of the detritus is in the navigable sections, whence its removal can be accomplished only by a steam dredge at the expense of the Government.

In the degree that the forests are damaged on the high watersheds, then, inevitable damage results to water power and navigation through increased extremes of high and low water and through vast deposits of gravel, sand, and silt in the stream channels and in any rersevoir which may have been constructed.

CONDITIONS IN THE SOUTHERN APPALACHIAN MOUNTAINS.

The Southern Appalachian Mountains contain approximately 9,900,000 acres, having an elevation above 2,500 feet.

The Blue Ridge and Great Smoky Mountains consist of an elevated plateau walled in on its western margin by a higher mountain range and with numerous short ranges projecting above its general surface. In one of these, the Black Mountains, Mount Mitchell rises to 6,711 feet, the highest altitude east of the Rocky Mountains. The eastern edge of the plateau is formed partly by peaks rising above the general surface and partly by an abrupt descent that forms an escarpment overlooking the Piedmont Plateau. Over 40 peaks, including approximately 6,400 acres, have an altitude of over 6,000 feet, and 54,000 acres are above 5,000 feet. The ridges of these mountains are rounded, the slopes precipitous, and the valleys deep cut and narrow. In Virginia the Blue Ridge narrows to a single range of a few miles width, but retains its characteristic topography. It crosses the Potomac River at Harpers Ferry, extends through the State of Maryland, and merges into the Allegheny Mountains in southern Pennsylvania.

The Allegheny Mountains extend southward from Pennsylvania and form the mountainous part of West Virginia and that portion of Virginia lying near the West Virginia boundary. The highest peak of the Alleghenies is Spruce Knob, in Pendleton County, W. Va., 4,860 feet.

The Cumberland Mountains are simply the extension of the Alleghenies and are considered to begin at the northeast boundary of Kentucky. From this line they extend southwest through Kentucky, extreme western Virginia, Tennessee, and into northern Alabama. The Cumberlands are of less elevation than the Alleghenies. Their highest peak is Big Black Mountain, in Harlan County, Ky., which has a height of 4,100 feet.

EROSION.

The greater part of the Southern Appalachian region is underlain by rocks that weather into soils which are easily eroded when exposed on deforested slopes. Erosion varies in character on account of the different kinds of soil. In some places the entire surface rapidly wears away, each freshet removing a thin layer, so that the fertile soil is soon exhausted. The field is at last worn out and abandoned.

This kind of erosion occurs on close-grained, compact clay soils, the particles of which cling together firmly and resist the downward cutting of small currents of water.

Another type of erosion results in parallel gullies extending straight up and down the slopes. As these gullies grow deeper they widen, the smaller ones are obliterated by the larger until they become of huge size, their bottoms sharp, their sides steep, and their edges irregular and jagged. Such erosion results from clay soils of homogeneous texture and somewhat softer and more loamy than the type mentioned above. It is a very common type, and the process once started can be stopped only with great difficulty. It nearly always results in the early abandonment of the field on which it begins.

Of all types of erosion, that of gullying, in which rapid down-cutting is accompanied by undercutting and caving, is the most rapid in its progress and the most difficult to check, as well as the most destructive in its effects. This type occurs in soils of relatively soft micaceous subsoil. The surface may be a fairly compact clay that offers moderate resistance to water, but once broken a gully results in the soft subsoil. It rapidly deepens, the micaceous material on the sides is easily undermined and slips in, leaving vertical or overhanging walls. Into such gullies many square yards of soil may cave during a single heavy rain, and as the decomposed micaceous material is usually scores of feet in thickness such gullies frequently become chasms of great depth and width. This kind of erosion when started on cleared land may advance into a forested area and undermine even the largest trees. The rocks which produce soil subject to this kind of erosion are found over a large part of the Southern Appalachian region, and especially in the Blue Ridge Mountains.

Still another type of erosion is that started by small landslides, which occur on steep slopes when the soil is saturated during periods of prolonged rainfall. Such landslides are often started by the trampling of cattle over the steep slopes during wet weather. One animal in climbing up or down a slope may start a number of such slides, each of which usually grows in width and length and soon makes a great bare scar in the field.

The soils subject to serious erosion are very extensive in the Southern Appalachian region. Where on such soils nature has placed a forest that brings about a balance between rainfall and run-off, the danger in widespread clearing is obvious. The loss resulting from erosion means not only the loss of the soil from the fields; it means also the loss which has already been described in the failure of water power and navigation.

MINING.

While in the Blue Ridge and Great Smokies no valuable coal deposits are known to exist, these mountains have a great variety of mineral resources. Many of them have never been developed, while others have become the basis of important mining operations. Large investments have been made in the mining of copper, marble, mica, corundum, talc, asbestos, slate, kaolin, and other minerals, and the mineral products are said to amount to several million dollars annually.

Such mining as is carried on does not require large quantities of timber, since but a small part of it is underground mining, and some

of that which is underground is carried on in the ancient crystalline rocks, which do not require timbering. The influence of such mining upon the forests is not very important except in a few instances where great damage is done. The most pronounced example of injury by mining is at Ducktown, Tenn., where sulphur fumes from the roasting and smelting of copper ores have killed all vegetation for a number of miles around. The perfectly bare surface has eroded with wonderful rapidity. It is a striking illustration of the completeness of destruction that may result from erosion in this region when the protecting forest cover is once removed.

In the Alleghenies and Cumberlands the mining of coal overshadows all other mining operations. This is one of the richest coal fields of the United States. The great mines which have been developed require annually millions of feet of timber, and will continue to require great quantities so long as the coal supply lasts.

Coal mining does not necessarily conflict with the proper use of the forest. It requires the use of usually less than 10 per cent of the surface, and this generally in the valleys. All the rest can be kept in timber. Moreover, the ownership and control of the surface do not necessarily go with the control of the coal rights. In many cases the companies which work the mines control only enough of the surface to enable them to operate the collieries.

AGRICULTURAL POSSIBILITIES.

In the northern part of Virginia the Blue Ridge is composed of sandstone which gives rise to the DeKalb stony loam, for the most part a poor, thin, stony soil. The summits are rough, rocky, and sharp-crested, while the slopes are steep and rocky. Probably 95 per cent of this type is uncultivated, and is valuable only for the timber it supports. The Blue Ridge, with its outlier, Short Mountain, is well defined, and soils suited to agriculture come to its base. Immediately across the Potomac, in western Maryland, similar conditions prevail. Farther south, in Virginia, the Blue Ridge soils are much more productive, and it is only the steep upper portions that are unsuited to farming. These higher areas are so steep, rough, and rugged that they are adapted only to forestry.

In western North Carolina, east of the Blue Ridge, lies a succession of foothills with moderately precipitous slopes and with small valleys between.

To the eastward lies the great agricultural Piedmont Plateau, from which little valleys follow back through the foothill region and into the mountains. At first these valleys are adapted to general farming, but as the region becomes more rugged they are pinched out and the soil is unsuited to cultivation.

ONLY SMALL AREA ADAPTED TO ORCHARD GROWING.

Where the Blue Ridge supersedes the foothills, many orchards have been planted on the better soils, and it is these in part which have given to western North Carolina the reputation of producing good fruit—a reputation justly deserved and capable of being much extended.

The success of apple orchards on soils and locations as already described, however, caused plantings to be made at greater and greater elevations, on very steep lands. As a result, orchards in such places are much less profitable than twenty years ago, simply from the increase in cost of labor, and eventually this item will, and in fact does already, make it impossible to compete in the production of apples with other areas where the decrease in the amount of labor necessary will more than offset the additional cost of land more economically worked. But even more striking is the problem of insect and fungus attacks. It is not economically feasible to plant orchards in the eastern United States where the land is so steep that the orchards can not be effectively sprayed at a reasonable expense, and the fact that this has been done in some cases in the past argues nothing for its probable success in the future.

Again, on some of these steep lands orchards have been planted at so great an elevation that the yield of fruit has been much lessened, the bloom having been destroyed or the trees winter-killed more often than at a more moderate elevation. The climate, then, goes hand in hand with the steep and rugged features and the character of the soils of large areas in this region to render their use for other than forest purposes impracticable.

The Great Smoky Mountains lying to the west and southwest of the Blue Ridge are generally rough and valueless for any purpose except the growing of timber. Throughout the higher mountains cultivation is impracticable because the soils rapidly erode when cleared and farmed. The sand and gravel washed from the mountain fields are carried down in large quantities to the lower courses of the streams in the piedmont region and deposited on valuable agricultural lands, rendering them valueless. Single floods will occasionally leave deposits several feet in thickness.

CUMBERLAND MOUNTAINS.

In the Cumberland Mountain region the soils are naturally much less productive than on and east of the Blue Ridge. They are more similar to the soils of the Great Smoky Mountains, being derived principally from sandstone. On the top of the escarpment which borders the Tennessee Valley on the west, the character of the topography is less rugged. The soils spread out more in the form of tablelands, which often include areas of level to moderately rolling land. The underlying rock, however, is so resistant to weathering that the soil has seldom accumulated to much depth, and often it is very stony from the fragments of sandstone. As a result, in many places these soils are ill suited to agriculture. When of sufficient depth to constitute agricultural land, moderate crops can be grown, but the soil is not naturally very productive and requires a good deal of fertilization. Transportation in this region also presents a difficult problem. The railroads have followed the little valleys, leaving the broad uplands between them, from which they are separated by a steep escarpment of 1,000 feet or more, in an isolated location; hence the possibilities for practicable and profitable agricultural development in this region are very limited.

FOREST.

The Southern Appalachian forests fall naturally into three types—cove, slope, and ridge—each with peculiar characteristics. The soil in the coves is usually deep, moist, and fertile. The naturally good conditions are supplemented where unaffected by fire by a deep, partially decomposed layer of humus, which increases the moisture-holding capacity and prevents erosion. Yellow poplar, maple, and hemlock are strictly limited to the coves. Black walnut and black cherry once occupied the cove land also. It is in the coves that the Southern Appalachian forest attains the greatest variety and luxuriance. It is here that growth is most rapid and the best quality of timber is produced. The situation is also best for lumbering, hence it was that the first cuttings of the Appalachian forests were in this type.

The slopes have a better-drained soil than the coves, but one which is less fertile. The maple, hemlock, and poplar of the coves give way on the lower slopes to oak, chestnut, and hickory, where these species have their most perfect development. White oak extends all the way from the coves to the summits of the ridges, but on the slopes it does best.

The ridges have a dry, stony soil and an exposed situation which distinctly affects the kind and quality of their timber. The more valuable trees of this type are chestnut, chestnut oak, black and red oaks, and sometimes white oak and white pine. The severe conditions result in scrubbier timber than is found on the slopes and unfit the ridge lands to be handled profitably for the production of saw timber. The lumbering of the ridges for the production of telephone poles, railroad ties, tanbark, and extract wood is profitable, but on account of the slow growth of the timber on the ridges the lumberman generally does not consider it profitable to cut conservatively and protect the young growth for a second crop.

DAMAGE THROUGH CLEARING.

Originally the forest covered almost the entire Southern Appalachian region. Due to clearing for agriculture, the forest is now confined to the mountains and to the valley lands which are stony, cut into steep hills, or wanting in fertile soil. All the best valleys are cleared. The fields in many places extend far up the mountain sides, frequently even to the summits.

In clearing land, only the undergrowth and small trees as a rule are removed. The large trees are killed by girdling and left standing. One frequently sees fields worn out and abandoned before the girdled trees have fallen. New ground is usually cleared beside the abandoned field and the same destructive process repeated. In places may be seen three successive clearings—new, still cultivated, and abandoned—with the dead trees still standing on all of them.

Clearing virgin forests for farms is going on steadily from year to year to replace worn-out, eroded, and abandoned lands. Always the movement is toward the higher lands, those lower down having finished their course.

Many small tracts, reaching thousands of acres in the aggregate, unsuited for either tillage or grazing, have been cleared, especially

along the Blue Ridge. Most of them are depreciating from erosion. While no longer in forest, they are fundamentally forest lands, and their earning power can only be reestablished by replacing the forest to which they are naturally adapted. While scarcely any of the remaining timbered land is as valuable for agriculture as for timber, under the present system a large portion of it is certain to be cleared.

LUMBERING AND FIRE.

The following table shows the area of forest in the mountainous part of each State, with the area and percentage of cut-over and virgin land:

TABLE 3.—*Forested area of the Southern Appalachian region.*

State.	Total forested area.	Unlumbered and lightly culled.		Lumbered and second growth.	
	Acres.	*Acres.*	*Per cent.*	*Acres.*	*Per cent.*
Alabama	3,730,000	509,000	14	3,221,000	86
Georgia	2,730,000	432,000	16	2,298,000	84
Kentucky	11,785,000	1,185,000	10	10,560,000	90
Maryland	716,000	30,000	4	686,000	96
North Carolina	4,771,000	1,628,000	34	3,183,000	66
South Carolina	831,000	142,000	17	689,000	83
Tennessee	16,483,000	2,584,000	16	13,899,000	84
Virginia	7,265,000	1,000,000	14	6,265,000	86
West Virginia	10,272,000	2,250,000	22	8,022,000	78
Total	58,583,000	9,760,000	17	48,823,000	83

Of the 58,583,000 acres of timberland, 17 per cent is uncut, while 83 per cent is cut over. The uncut timber as a rule is in the higher, more inaccessible parts of the mountains. Occupying the ridges and higher slopes, it is unequal in quality and stand to the timber of the lower slopes and coves. The cut-over lands are in all stages and conditions of reproduction and growth. From some of it has been removed only the best species, such as walnut and poplar. From most of it the chestnut and oak, which form the main body of the forest, have also been cut.

Over practically all of it, whether cut over or not, fires have burned repeatedly and destroyed a large proportion of the young trees, which, if allowed to grow, would now represent growth of from one to fifty years. In like manner the undergrowth and the humus, both vital parts of the forest, have suffered great injury. Following fire, insects have at times wrought great local damage.

Lumbering is going on more extensively in the hardwood forests of the Southern Appalachians than ever before. While in the past seven years the hardwood cut has decreased in West Virginia, Kentucky, and Tennessee, the diminution of cutting has been chiefly in the more level parts of these States. In the mountains, where heavy cutting has not been going on for so long, the cut is probably as heavy or heavier than ever. In North Carolina cutting in the mountains has been heavy enough to increase the output of the entire State.

There has been little tendency on the part of the lumberman to conservative cutting. The usual belief is that, because of the danger

from fire and the high taxes on lands with standing timber, it does not pay to cut lightly and protect the land for a second crop. Hence the lumberman cuts the timber as heavily as possible, gets as much money out of it as he can, and then transfers his operations to another tract. It is the same principle as the mountain farmer adheres to when he abandons a worn-out field for a new one.

Lumbering is attended with almost as much waste as ever. Actual measurements in average operations of hardwood tie making show that from 75 to 82 per cent of the whole tree and from 43 to 73 per cent of the logs used is wasted. We realize that the waste is enormous when we consider that probably 20,000,000 ties, each containing 2⅔ cubic feet, are cut in this region every year. Railroad ties are only one product. The manufacture of lumber and the making of telephone poles and cooperage stock are attended with waste almost as great.

The only industry that uses the forest without much waste is the tannin-extract business, which, while using up the mature timber, is open to objection in that it takes the chestnut and oak forests almost clean, young trees and all.

Several active influences are thus constantly operating to reduce the area and deteriorate the quality of the Southern Appalachian forests. Clearing, destructive lumbering, and fire are far the most prevalent and damaging, but grazing, mining, and insects contribute to the injury in a local way. Although the area of the forest is much less than formerly, these agencies are at work more actively than ever before. Their combined influence, if unchecked, is sufficient practically to obliterate the commercial forest of the Southern Appalachians within the next sixteen years. All that is needed for this result is a continuation of present conditions.

CONDITIONS IN THE WHITE MOUNTAINS.

TOPOGRAPHY.

The White Mountain region is drained by five large rivers—the Connecticut, the Pemigewasset, the Saco, the Androscoggin, and the Kennebec. The watersheds of these streams form a very rough and rugged region broken up into many short mountain ranges separated by deep, narrow valleys. The White Mountains proper, the most rugged and elevated portion, cover about 812,000 acres. Seventy-four peaks reach a height of over 3,000 feet, and of these eleven are over 5,000 feet. The tallest, Mount Washington, rises to an altitude of 6,290 feet, and is among the tallest peaks east of the Mississippi River.

A characteristic of the topography is the great irregularity of arrangement of the mountains. With the exception of the Presidential Range, there are no long ranges. The greatest number of peaks are in irregular groups, or isolated. The three main ranges, the Presidential, the Carter-Moriah, and the Franconia, have a general northeast and southwest direction.

The Presidential Range is the most important. In it are included nine of the eleven peaks with elevations above 5,000 feet. It is popularly considered as extending only from Mount Madison on the

north to Mount Webster on the south, and includes the following peaks: Madison, the three Adamses, Jefferson, Clay, Washington, Monroe, Franklin, Pleasant Dome, Clinton, and Webster. This stretch of country is about 15 miles long by 5 miles in breadth and contains about 50,000 acres.

This range is the source of five rivers, by which it is drained—the Saco, the Ammonoosuc, and Israel, tributaries of the Connecticut, and the Moose and Peabody, tributaries of the Androscoggin.

The underlying rock is granitic gneiss. By disintegration and mixture with organic matter it forms a loamy sand. The depth of the soil varies with the elevation, aspect, and gradient. In the valleys and on the lower slopes the soil is generally deep, with little outcropping rock. With ascent in altitude and increase in gradient the depth increases, till on the steep upper slopes there are only immense masses of bare outcropping rock and scattered bowlders.

Next to the Presidential Range, the Carter-Moriah Range is of the most importance. It runs parallel to the Presidential Range and is separated from it by the Glen Ellis and Peabody rivers. The highest peak is Carter Dome, with an elevation of 4,860 feet, and there are eight peaks in all, with elevations of over 4,000 feet. The general character of the soil and underlying rock is the same as on the Presidential Range. The range is about 20 miles long and from 2 to 7 miles wide. It is entirely surrounded by the five rivers by which it is drained—the Peabody and Glen Ellis rivers on the west, the Wild and the east branch of the Saco on the east and south, and the Androscoggin on the north. The Peabody and Wild rivers flow northeast into the Androscoggin, and the Glen Ellis flows into the Saco.

The northern part of the White Mountain region, in Coos County, N. H., is flatter than the White Mountains proper, and contains many lakes and low mountains with wide rolling valleys between. The Connecticut Lakes, the headwaters of the Connecticut River, lie in the northern part of this region. These lakes are small. The protection of the watershed around them is therefore of greater importance than if they were large and formed a greater storage area for water.

The area in Maine includes 700,000 acres in Oxford and Franklin counties. This entire region is very rough and rugged, containing no regular ranges of mountains, but being broken up into a great number of irregular peaks and ridges. The five Rangeley lakes, the headwaters of the Androscoggin River, lie in the southern part of this region. North of these lakes, in the Magalloway, Cufsuftic, and Kennebago watersheds, the country is extremely rough, including a great number of tall mountain peaks, extending up to the Boundary Mountains between the United States and Canada. The extreme eastern portion of this area lies in the Dead River watershed, the extreme headwaters of a tributary of the Kennebec River. The land in this watershed is flatter than to the west and contains many small lakes, ponds, and bogs. For this reason the protection of the watersheds is not of so great importance as in the more mountainous country to the west, and the main watershed of the Kennebec River has not, therefore, been included in the proposed boundary lines.

AGRICULTURAL POSSIBILITIES.

The entire region is essentially a forest country. That the land is, for the most part, better suited to forest production than to agricultural use is evidenced by the once cultivated lands which have now come up to forests of second-growth spruce and pine. Where repeated fires have not kept back the young growth these give good promise for the future. Thousands of acres of once cleared land have been abandoned throughout the White Mountains, and a smaller area of land is now farmed than fifty years ago. Only along the intervales and valley bottoms is good farming land found.

The farm land in the Saco drainage basin, which contains the largest area of cultivated land in the White Mountain region proper, lies chiefly in the eastern and southern portions. The soil is sandy and poor, and except right along the streams the farming is not good. The principal crops are clover and timothy hay, oats, rye, wheat, corn and potatoes, peas and beans. There are a few orchards, usually overgrown and neglected.

North of the White Mountains proper practically no land has been cleared for agricultural purposes, and in the greater part of this country there are no settlements of any kind save the logging camps and an occasional hunter's cabin or summer hotel or camp.

FOREST.

Originally the entire northern region, including the White Mountains proper, was covered with a dense forest of conifers. It was primarily a spruce country, and the spruce here attained fine dimensions. White pine, too, covered large areas and was mixed with spruce over much of the region. Balsam occurred in mixture on the upper slopes and the lower, moister localities. There was originally very little fine hardwood forest except south of the main ranges of the White Mountains.

In the White Mountains proper, red spruce and balsam are the prevailing species, and reach the highest elevations on the mountains. North of the White Mountains these trees with white cedar, and around the Connecticut Lakes with white spruce, are the chief conifers. Lumbering has brought about a great change in the species. Hemlock and white pine, once common at low elevations and along the valleys, are now of but little importance in the forest. Yellow birch, sugar maple, and beech are the commonest of the hardwoods and have greatly increased in numbers on the cut-over land. But little of the original forest is now left. Where there was formerly a heavy stand of spruce and balsam there is now a hardwood forest with a little spruce in mixture. Where fires have occurred there is a tangle of wild red cherry, yellow birch, and aspen.

Hardwoods occur on the lower slopes and deeper, better soils. Here yellow birch, sugar maple, and beech are now the characteristic trees, with considerable spruce in mixture. The spruce forms a better timber tree on these slopes than in any other situations. These hardwood slopes rarely extend above an altitude of 2,400 feet. The forest is, as a rule, dense and clean, with a heavy shade. The ground cover consists chiefly of witch hobble, mountain maple, and moun-

tain ash. The shade is too heavy for good softwood reproduction, but the reproduction of hardwoods, particularly of sugar maple and beech, is often very thick, with a dense matting of young seedlings covering the ground. Very little of this type is now left in virgin forest in the White Mountain region itself, since it was easily lumbered.

Spruce and balsam occur at present on the steeper slopes where the soil is shallow, and the hardwoods do not thrive so well. Unmerchantable spruce and balsam are found on the extreme upper slopes and finally run out into a scrubby growth near the summits. The stand is usually dense. Where the forest has been undisturbed the ground cover is moss. The balsam reproduction is often very thick and the spruce reproduction generally fair.

Spruce slopes cover the greatest area of any of the forest types in this region. Where these slopes are cut over, if fire is kept out, the softwoods return in the second growth. Where fire runs over the ground after lumbering, however, in many cases the entire soil is burned and washed away and the process of return to forest conditions is very slow. In some cases, as on the Sugar Loaves, in the township of Carroll, it will never be complete.

There is practically no real swamp land in northern New Hampshire, although in places the spruce flats approach such a type. There are, however, small areas of swamp of spruce bogs, chiefly in the northern part of Coos County. These have a very dense, scrubby growth of black and red spruce and balsam. In Maine such bogs are more common, and a number of swamps are found, particularly in the Cufsuftic watershed.

LUMBERING AND FIRE.

Six large lumber and pulp companies are now engaged in logging operations in this region, besides a large number of smaller concerns. But little virgin spruce timber is now left, and at the present rate of lumbering it can last but a few years longer. As far as possible these companies get their present supplies by purchasing stumpage on small holdings in order to preserve the timber on their own lands as long as possible, and owing to the fact that stumpage can now be bought cheaper than it ever can again. When these small holdings are lumbered in this way, they are almost always "skinned" to the last merchantable stick. Owners of the smaller tracts themselves often cut their woodlands in the same manner in order to get as much present revenue as possible. Throughout the mountains the worst destruction has been done on the high slopes, and fire has often followed with terrible results.

Clean cutting is practiced on all the steeper slopes. The spruce logs are rolled down the slope to the road below over the merchantable stuff and the hardwoods, which are first felled down the slope and thus form a good rolling bed. The hardwoods are left lying on the ground unused. The result is a veritable fire trap that lasts for years. In 1903, 84,250 acres of land were burned over in the White Mountain region. While this land was for the most part cut over, a conservative estimate would place the amount of damage at something over $200,000. This was a particularly bad year for fires, but the same conditions of drought may occur at any time, and, without proper protection, the area burned over may even exceed that burned

in 1903. Once a fire starts on cut-over lands, with wind and weather favorable to its spread, it is usually impossible to combat it with any success. Where the cut has been heavy and the resulting débris correspondingly large, all the difficulties of fire fighting are proportionately increased. All kinds of waste material left in the woods supply food for the flames, but the leaving of large, unlopped softwood tops on the ground adds enormously to the fury of a brush fire and greatly prolongs the length of time that a slash remains a menace to its own and surrounding areas. These large tops, propped up from the soil by their branches, are very slow to decay and become very dry. A large area in the Zealand Valley was burned over in 1903, eleven years after the last lumbering. This valley, which had been logged for spruce saw logs only, is an example of the great length of time that cut-over land must be specially protected against fire even when a very large proportion of the stand is left after logging.

Fires on cut-over land usually kill all standing timber left, as well as all the young growth. On the steep slopes, where they are particularly likely to spread, owing to the method of clear cutting on such slopes, the destruction of the soil is almost certain. On many slopes the presence of any forest growth whatever is due to the accumulation, through the ages, of a mass of organic matter which held the mineral particles of rock as they were gradually disintegrated, preventing their being washed to the bottom of the slope. The soil that obtains to-day on such areas is very largely organic matter, and when fire-swept, if dry, is so nearly consumed, especially by repeated fires, that the remaining mineral particles are easily washed away until nothing but bare rocks remain. A thousand years will not replace this soil and a growth of trees upon it.

On such areas the water run-off is much more rapid than on uncut or even on cut but unburned areas, as nothing remains to retard or hold the rain water on the slopes. There is little left but bare rocks, and the water runs off very rapidly, causing floods and freshets in the valleys below and extremely low water soon after, owing to the fact that little water is retained on the slopes to be given out later as on forested land.

VALUE FOR RECREATION.

The White Mountains are visited annually by thousands of people from every State in the Union, and from foreign countries as well. No other section of the country is so accessible to so many of the greater eastern cities. In consequence, it forms a great recreation ground for thousands of people. The very existence of the region as a summer resort depends directly upon the protection of the forest from fire and destructive lumbering, which absolutely destroy the beauty of the landscape. The virgin forest still remaining in the White Mountain region proper is practically confined to two localities—one on the northern slope of the Presidential Range, and the other that in Waterville. Clear cutting of this virgin growth will undoubtedly greatly detract from the value of these localities for summer resorts. The natural beauty of the mountains is enhanced by their forest covering. Without this they are bare and unattractive, and when fires occur after logging the landscape is rendered bleak and desolate.

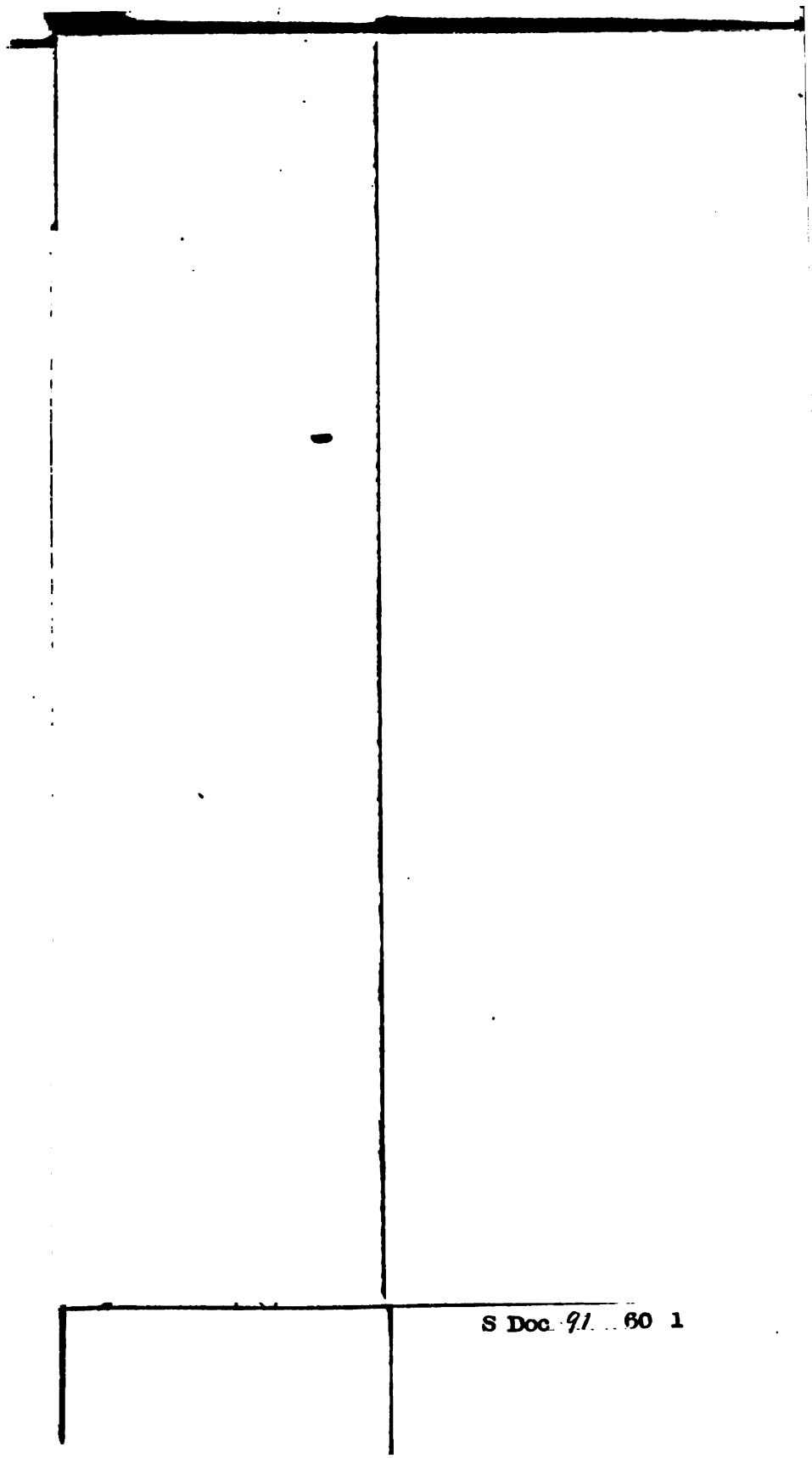
AREAS OF ESPECIAL IMPORTANCE.

Owing to the high price that would have to be paid for virgin forest land, but little of such land can be bought. Certain small areas of virgin forest should, however, be preserved, surrounding places of particular importance, as recreation grounds. The destruction of the forest upon them would almost completely destroy their value. These places are frequented by thousands of people annually, and their preservation is of great importance. On invitation, representatives of the Appalachian Mountain Club, the Massachusetts Forestry Association, and the Society for the Protection of New Hampshire Forests cooperated with the Forest Service in locating five such areas. Their combined area will not exceed 5,000 acres.

One area is located on the north slope of the Presidential Range around the ravine of the Cascades and extends from an area that has been recently logged over up to the limit of merchantable timber at an elevation of 4,000 feet. It includes the slopes on both sides of and above the Cascade Falls. These falls are much frequented by campers and vacationists, and this would be the only area of virgin timberland left on the north slope of the Presidential Range. Another area is located around the Glen Ellis Falls and extends in a narrow strip from here, on both sides of the trail, up through Tuckermans ravine on the slopes of Mount Washington to an elevation of 4,000 feet, the limit of merchantable timber. Another area is situated on the East Branch of the Pemigewasset River, where Cedar and Shoal Pond brooks come in. This is a popular camping spot for parties crossing from the Crawford Notch region through the Pemigewasset Valley to North Woodstock, and is very much used for camping. Another tract is situated 7 miles west of North Woodstock on the Mousilauke Brook. At this point, about 1 mile from its source on Mount Mousilauke, the brook disappears underground and flows through a series of caverns for a distance of nearly half a mile, being here called "Lost River." This underground stream is one of the remarkable natural features in the White Mountains. Some twenty or more caverns make the whole place one of unusual interest. Still another area is Eagle Cliff, which is a combination of six mountains, ranging in height from 2,400 to 3,100 feet, all combined in one massive group, in the Franconia Notch. The south side of this cliff is very steep and overlooks the Profile House, but on the opposite (north) side it is more sloping in character, extending down to the wild bed of Lafayette Brook, and is covered with a forest growth, mixed spruce and hardwoods, of remarkable evenness and beauty. It is the most prominent forest on the Franconia Range and one of the most prominent to be found on any of the mountains.

AREA AND LOCATION OF LANDS NEEDING PROTECTION.

In order to determine the extent of the lands primarily available for forests in the Southern Appalachian and White Mountain regions, a reconnaissance survey has been made, as a result of which the accompanying maps have been prepared. Maps I and II show for the two regions the lands to be classed as distinctly mountainous and nonagricultural.



The main centers for such mountainous and nonagricultural lands in the Southern Appalachians are, first, the Blue Ridge and Great Smoky Mountains of North Carolina and Tennessee, South Carolina and Georgia; second, the Allegheny Mountains of eastern and southern West Virginia and western Virginia, and, third, the Cumberland Mountains of eastern Kentucky, Tennessee, and northern Alabama. These lands include the main mountain ranges, and the roughest, wildest land of the region. Naturally, they embrace a smaller proportion of agricultural lands than other parts of the region, and those which they do embrace have for the most part been eliminated, as will be seen from the irregular boundaries on the map. Regardless of these eliminations they still include some small bodies of agricultural lands. These areas, though they contain only 40 per cent of the timbered land of the Southern Appalachians, include almost all of the virgin timberlands, because the virgin timber which remains is mostly situated on the high mountains. Even though these lands do produce an inferior grade of timber, their sole use must be for timber production. There is no other crop which will hold the gravelly, stony soil in place and keep it from clogging the channels of streams and covering the agricultural valleys which lie below. These nonagricultural and mountainous lands, approximating 23 million acres, give rise to all the important streams which have their source in the Southern Appalachians. They are therefore the vital portions of these mountains. Whatever work is done to protect the Southern Appalachians must center in these areas. The proportion to which these lands fall into different States and watersheds is shown in the following tables:

TABLE 4.—*Area, by States, of nonagricultural and mountainous lands in the Southern Appalachians.*

State.	Area.	State.	Area.
	Acres.		*Acres.*
Tennessee	4,962,000	West Virginia	5,797,000
Virginia	3,882,000	South Carolina	590,000
Alabama	491,000	Maryland	277,000
Georgia	1,806,000		
Kentucky	1,623,000	Total	23,310,000
North Carolina	3,882,000		

TABLE 5.—*Area, by watersheds, of nonagricultural and mountainous lands in the Southern Appalachians.*

Watershed.	Area.	Watershed.	Area.
	Acres.		*Acres.*
Tennessee	2,489,000	Yadkin	428,000
Cumberland	2,759,000	Big Pigeon	20,000
Holston	582,000	Catawba	502,000
James	1,138,000	Broad	299,000
Roanoke (Staunton)	431,000	Potomac	2,095,000
New (Kanawha)	3,225,000	Chattahoochee	345,000
Big Sandy	1,347,000	Little Pigeon	19,000
Hiawassee	1,066,000	Twelve Pole	1,000
Little Tennessee	1,307,000	Savannah	860,000
French Broad	623,000	Guyandotte	660,000
Pigeon	255,000	Saluda	100,000
Little River	202,000	Kentucky	156,000
Monongahela	987,000	Coosa	767,000
Nolichucky	379,000		
Youghlogheny	117,000	Total	23,310,000
Rapidan	151,000		

While the lands shown on the map are all in need of protection, they are not all of equal importance when all economic points of view are considered.

The lands to be classed as of first importance include the mountain ridges mainly, but extend considerable distances down the slopes in those localities where the soil is particularly subject to erosion and on the watersheds of streams of greatest importance for water power or navigation. The area of such lands does not exceed 5,000,000 acres.

The same class of land for the White Mountain region is shown in Map II. It lies in both New Hampshire and Maine. Excluding the numerous bodies of water, their area in New Hampshire is 1,457,000 acres, and in Maine 700,000 acres, making a total of 2,157,000 acres. The proportion in which this falls in the five water systems included is as follows:

	Acres.
Connecticut	429,000
Merrimac	264,000
Saco	332,000
Androscoggin	1,002,000
Kennebec	130,000
Total	2,157,000

There is also shown on this map an area embracing only the four main ranges of the White Mountains. A few thousand acres of this area lie in Maine. All the rest is in New Hampshire. *This principal White Mountain area covers 668,000 acres, and, considering all economic points of view, is the most important part of the region.*

TREATMENT OF THE REGION.

The areas indicated in the preceding section, 23,310,000 acres in the Southern Appalachians and 2,157,000 acres in the White Mountains, do not include all the mountainous timberlands of the Appalachians. As is discussed under the heading "Importance of Appalachian forests for hardwood supply," there are probably 75,000,000 acres in this mountain system more important for timber production than for any other purpose. This area will have to be given protection before the hardwood supply is on a safe footing and before the watersheds of the important streams are adequately safeguarded.

It is an enormous undertaking to bring this immense area of 75,000,000 acres under proper conditions of protection and use. If the Government owned the land, the problem would be a comparatively simple one under our present forest policy. The Government owns almost none of it, and it can not be expected to undertake the purchase of such an area which at present prices would amount to many millions of dollars.

The land is owned by individuals or companies whose chief interest is immediate profit. Considering past and present conditions one is forced to the conclusion that the individual holders are not going to manage these lands in a way commensurate with public welfare. On account of the difficulty of protecting them from fire, and on account of the high tax rates which are common on cut-over timberlands, the owners consider that it does not pay them to do so.

The several States of the Appalachian region can not protect these lands as a whole. They may control certain areas of them, as the States of New York and Pennsylvania are doing, but as a rule the national or interstate bearings of the problem are such as to make it unreasonable to expect that the States will purchase these lands and put them under management. A few examples make this clear. No State of the group feels it incumbent upon itself to provide the Nation's supply of hardwood timber. The State of West Virginia does not feel keenly the necessity of protecting the upper watershed of the Monongahela River because certain cities of Pennsylvania, Ohio, and Kentucky are inundated and suffer damage by the Monongahela floods. North Carolina will never purchase and protect the headwaters of the Yadkin and Catawba rivers because the navigation and water-power interests on these streams in South Carolina suffer from the denudation of the mountain forests. In the case of almost every watershed there are complications of this kind.

While none of the three, the Federal Government, the individual holders, or the several States, can be expected to try to solve the problem as a whole, the problem is nevertheless so important that it must be solved, and all three are in a position to be keenly interested in its solution. Therefore it is necessary to consider whether a way may be found by which all three may participate in solving it.

Since the lands are now in the hands of individuals the simplest procedure would appear to be by an arrangement whereby the greater part of the region could be handled by individuals so that the property would not change control. Considering the vast extent of the lands, it seems almost inevitable that if they are to be protected at all, they must be protected mainly by the individuals who own them. Can this be done? It can be done, if at all, only by making it profitable for individuals to hold these lands after cutting them over. It may be stated as the rule that timberland owners would not want to sell their lands and would put forestry into effect upon them if it were not for the difficulty of protecting them from fire and the high rate of taxation which prevails in many parts of the Appalachian region. But individuals alone can not overcome these great obstacles.

What individuals under present conditions can not do, however, can be made possible by the States. It is possible for the States to pass such laws for fire protection as to insure the safety of the most valuable timberlands. This is being done by a number of the States with considerable and increasing success. The problem of equitable taxation for forest lands is a more difficult one and it has not as yet been solved. Its solution is necessary, however, and necessary in the immediate future.

If the States of the Appalachian region would set themselves to the providing of efficient fire laws and the solution of the question of forest taxation, they would do a work of incalculable importance in the protection of the Appalachian forests. They would make it not only possible but profitable to put under protection and conservative management practically all of those lands which are suited to the production of the most valuable kinds of timber, and which are accessible for economical administration and lumbering.

The question of the acquirement of timberlands by the Government has been considered with the principal owners of the region. While unwilling to dispose of their virgin timberlands except at very high prices, they are willing to consider the sale of their cut-over lands, the lands lying too high for lumbering, and the mountain tops.

A careful study of the situation leads to the conclusion that most of the lands of these classes can be bought at an average price of $6 per acre.

Although it may be necessary to make cut-over lands the basis of purchase, so far as possible purchase should be made of uncut lands under an arrangement whereby the owner may cut the timber under the regulations of the Department of Agriculture. This would leave the land in far better condition than the average cut-over land, and the Government could well afford to pay a higher price for land under this management.

SOUTHERN APPALACHIAN MOUNTAINS.

In the Southern Appalachians the timberlands are owned by large companies to a less extent than in the White Mountains, but even here as much as 50 per cent of many localities is under such ownership. Likewise lumbering is going on less vigorously in the Southern Appalachians than in the White Mountains. This is accounted for by the fact that the Southern Appalachian region is large and many localities of it are very inaccessible. Logs can not be driven downstream as in the North, and railroads are lacking. Consequently, the price of timber all along has been and is now lower than in the North. For instance, spruce which in the White Mountains is worth on an average about $6 per thousand on the stump is in the high southern mountains worth only $2.50 to $3 per thousand.

Timberland owners in the Southern Appalachians are generally inclined to sell their lands to the Government at a reasonable price, regardless of whether the lands contain virgin timber or are cut over. Furthermore, many of them are favorable to the transfer of their lands, themselves retaining the right to cut and remove certain kinds of timber above specified sizes.

In considering the practicability of the Government's purchasing land for national forests in the Southern Appalachians conference has been freely had with timberland owners, lumbermen, real estate dealers, and title examiners. Moreover, attention has been paid to the sales which have been made during the past two years and the prices which have been paid.

The price of virgin hardwood land varies from $5 to $12 per acre, depending on accessibility and kind and quality of timber. Cut-over lands are worth from $2 to $5 per acre, their value likewise depending upon their location and the condition of the timber growth upon them.

In the Southern Appalachians, as in the White Mountains, it will be inadvisable for the Government as a rule to attempt the purchase of virgin forest lands. It should make cut-over lands the basis of purchase, and for such lands it should not exceed an average price of $3.50 per acre.

Neither in the White Mountains nor Southern Appalachians is it true that the Government will have to pay higher prices than would

have to be paid by individuals in purchasing the same lands. Some landowners might attempt to charge the Government more, but, on the other hand, there are those who appreciate the advantages of the Government's going into this work, and they would rather sell to the Government than to any other purchaser.

To purchase land economically in either region the Government should not limit itself closely either as to time or locality. Purchase should be undertaken in several localities at once, as in this way competition can be induced.

There should be no undue anxiety or haste to acquire land in any particular locality. Haste would mean the fixing of too high a standard of prices and result in waste of money, and besides would certainly involve the Government in difficulty with respect to titles, which in both regions present complications. The acquirement of the necessary lands in either region can best be accomplished by a steady process worked out through several years of purchasing those lands which are desirable, which are offered at the most advantageous rates, and to which valid title can be secured.

The right to take lands under condemnation proceedings would be helpful, especially, in some instances, to perfect title, but the condemnation right must be handled with the greatest care and judgment and should be used only to clear title and in other cases of extreme necessity.

RECOMMENDATIONS.

In view of the conditions described on the foregoing pages, it is clear that the Government should undertake without delay the acquisition of a definitely restricted amount of land in specified watersheds in the White Mountains and in the Southern Appalachians for the establishment of national forests.

In the White Mountains it is recommended that the Government acquire an area of not to exceed 600,000 acres within the area designated on the accompanying map and so situated as to embrace as much as possible of the Presidential, Franconia, Sandwich, and Carter-Moriah mountain ranges; that a limit of $6 per acre be fixed as the average price to be paid for cut-over lands; that an appropriation of $1,250,000 be made immediately available for such purchase: furthermore, that $250,000 additional be appropriated for the purchase of the timber in its present condition, surrounding the five important recreation points described on page 30.

In the Southern Appalachians it is recommended that areas aggregating not more than 5,000,000 acres be purchased within the limits designated on the accompanying map, and distributed, as may seem advisable, over the higher watersheds of the following rivers: Potomac, James, Roanoke, Yadkin, Catawba, Broad, Saluda, Savannah, Chattahoochee, Coosa, Tennessee, New, Cumberland, Kentucky, Monongahela; that the limit of average price be fixed at $3.50 per acre; and that an appropriation of $3,500,000 be made immediately available to begin the purchases.

It is recommended also that the Government adopt in both regions a policy of cooperation with timberland owners in order to bring about the protection of private forests from fire, and the general adoption of improved methods of cutting.